

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
18 March 2004 (18.03.2004)

PCT

(10) International Publication Number
WO 2004/023573 A3

(51) International Patent Classification⁷: **H01L 51/40**

(21) International Application Number:
PCT/GB2003/003960

(22) International Filing Date:
3 September 2003 (03.09.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0220404.8 3 September 2002 (03.09.2002) GB
60/480,502 20 June 2003 (20.06.2003) US

(71) Applicants (*for all designated States except US*): **CAMBRIDGE DISPLAY TECHNOLOGY LIMITED** [GB/GB]; IP Department, Greenwich House, Madingley Rise, Madingley Road, Cambridge, Cambridgeshire CB3 0TX (GB). **GENERAL ELECTRIC COMPANY** [US/US]; CRD Patent Docket Room K-1/4A59, Niskayauna, NY 12309 (US).

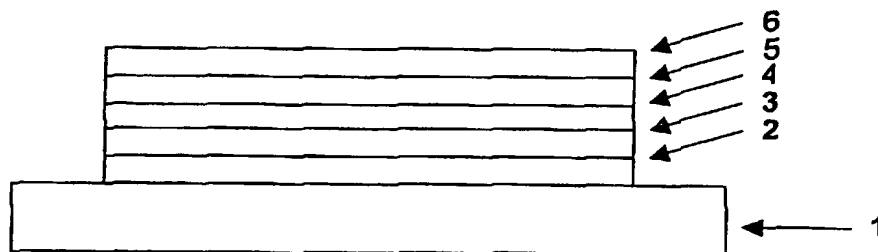
(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **ARCHER, Robert** [GB/GB]; c/o Cambridge Display Technology Limited, Greenwich House, Madingley Rise, Madingley Road, Cambridge, Cambridgeshire CB3 0TX (GB). **BAYNES, Nicholas** [GB/GB]; c/o Cambridge Display Technology Limited, Greenwich House, Madingley Rise, Madingley Road, Cambridge, Cambridgeshire CB3 0TX (GB). **BUTLER, Timothy** [GB/GB]; c/o Cambridge Display

Technology Limited, Greenwich House, Madingley Rise, Madingley Road, Cambridge, Cambridgeshire CB3 0TX (GB). **CINA, Salvatore** [IT/FR]; 12 Rue Casimir Brenier, F-38000 Grenoble (FR). **FODEN, Clare** [GB/GB]; c/o Cambridge Display Technology Limited, Greenwich House, Madingley Rise, Madingley Road, Cambridge, Cambridgeshire CB3 0TX (GB). **FORSYTHE, Daniel** [GB/GB]; c/o Cambridge Display Technology Limited, Greenwich House, Madingley Rise, Madingley Road, Cambridge, Cambridgeshire CB3 0TX (GB). **LEAD-BEATER, Mark** [GB/GB]; c/o Cambridge Display Technology Limited, Greenwich House, Madingley Rise, Madingley Road, Cambridge, Cambridgeshire CB3 0TX (GB). **MURPHY, Craig** [GB/GB]; c/o Cambridge Display Technology Limited, Greenwich House, Madingley Rise, Madingley Road, Cambridge, Cambridgeshire CB3 0TX (GB). **PATEL, Nalinkumar** [GB/GB]; c/o Cambridge Display Technology Limited, Greenwich House, Madingley Rise, Madingley Road, Cambridge, Cambridgeshire CB3 0TX (GB). **PHILLIPS, Nathan** [GB/GB]; c/o Cambridge Display Technology Limited, Greenwich House, Madingley Rise, Madingley Road, Cambridge, Cambridgeshire CB3 0TX (GB). **ROBERTS, Matthew** [GB/GB]; c/o Cambridge Display Technology Limited, Greenwich House, Madingley Rise, Madingley Road, Cambridge, Cambridgeshire CB3 0TX (GB). **DUGGAL, Anil, Raj** [US/US]; 2322 Algonquin Road, Niskayuna, NY 12309 (US). **LIU, Jie** [CN/US]; 1265 Sagemont Court, Niskayuna, NY 12309 (US).

[Continued on next page]

(54) Title: OPTICAL DEVICE



(57) Abstract: A method of forming an optical device comprising the steps of: - providing a substrate comprising a first electrode capable of injecting or accepting charge carriers of a first type; - forming over the first electrode a first layer that is at least partially insoluble in a solvent by depositing a first semiconducting material that is free of cross-linkable vinyl or ethynyl groups and is, at the time of deposition, soluble in the solvent; forming a second layer in contact with the first layer and comprising a second semiconducting material by depositing a second semiconducting material from a solution in the solvent; and - forming over the second layer a second electrode capable of injecting or accepting charge carriers of a second type wherein the first layer is rendered at least partially insoluble by one or more of heat, vacuum and ambient drying treatment following deposition of the first semiconducting material.



(74) **Agent:** SHADE, Matthew; Representative - Registration No. 45072, Cambridge Display Technology Limited, Greenwich House, Madingley Rise, Madingley Road, Cambridge, Cambridgeshire CB3 0TX (GB).

European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(81) **Designated States (national):** AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(88) **Date of publication of the international search report:**
16 September 2004

(84) **Designated States (regional):** ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 03/03960

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01L51/40

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99/54385 A (DOW CHEMICAL CO) 28 October 1999 (1999-10-28) page 13, line 12 - line 31	1-29, 39, 40
X	WO 97/32452 A (UNIX CORP) 4 September 1997 (1997-09-04) page 13, line 7 - line 31	30-38
X	WO 94/03030 A (KRAFT ARNO ; BRADLEY DONAL DONAT CONOR (GB); HOLMES ANDREW BRUCE (GB);) 3 February 1994 (1994-02-03) claims 11-17 page 10	1-29, 39, 40
X	WO 00/55927 A (TOWNS CARL ROBERT ; DELL RICHARD O (GB); CAMBRIDGE DISPLAY TECH (GB);) 21 September 2000 (2000-09-21) claims 63-65	25-29
	----- -/-	

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents :

A document defining the general state of the art which is not considered to be of particular relevance

E earlier document but published on or after the international filing date

L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

U document referring to an oral disclosure, use, exhibition or other means

P document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

A document member of the same patent family

Date of the actual completion of the international search

13 July 2004

Date of mailing of the international search report

20/07/2004

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Bader, K

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 03/03960

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 98/05187 A (PICHLER KARL ; TOWNS CARL (GB); CAMBRIDGE DISPLAY TECH (GB)) 5 February 1998 (1998-02-05) cited in the application page 9 - page 16	1, 25-30, 39, 40
A	US 6 107 452 A (SCOTT JOHN CAMPBELL ET AL) 22 August 2000 (2000-08-22) cited in the application examples 1-4	1, 25-30, 39, 40

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 03/03960

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9954385	A	28-10-1999	US 6309763 B1 CA 2294485 A1 CN 1263542 T DE 69908522 D1 DE 69908522 T2 EP 0988337 A1 JP 2002506481 T WO 9954385 A1 US 2001026878 A1	30-10-2001 28-10-1999 16-08-2000 10-07-2003 15-04-2004 29-03-2000 26-02-2002 28-10-1999 04-10-2001
WO 9732452	A	04-09-1997	US 5798170 A AU 2192197 A EP 1021934 A1 WO 9732452 A1	25-08-1998 16-09-1997 26-07-2000 04-09-1997
WO 9403030	A	03-02-1994	DE 69306115 D1 DE 69306115 T2 EP 0653148 A1 WO 9403030 A1 HK 37697 A JP 3478824 B2 JP 7509338 T US 5747182 A	02-01-1997 10-04-1997 17-05-1995 03-02-1994 04-04-1997 15-12-2003 12-10-1995 05-05-1998
WO 0055927	A	21-09-2000	AU 2740299 A AU 3177700 A CA 2367388 A1 CN 1347572 T EP 1169741 A1 EP 1062703 A1 WO 0055927 A1 JP 2002507825 T JP 2002539292 T TW 525409 B	11-10-1999 04-10-2000 21-09-2000 01-05-2002 09-01-2002 27-12-2000 21-09-2000 12-03-2002 19-11-2002 21-03-2003
WO 9805187	A	05-02-1998	CN 1227040 A ,B DE 69710781 D1 DE 69710781 T2 EP 0915925 A1 EP 0947123 A1 WO 9804610 A1 WO 9805187 A1 GB 2331400 A ,B JP 2000516275 T JP 2000516760 T US 6423428 B1 US 6605823 B1	25-08-1999 04-04-2002 31-10-2002 19-05-1999 06-10-1999 05-02-1998 05-02-1998 19-05-1999 05-12-2000 12-12-2000 23-07-2002 12-08-2003
US 6107452	A	22-08-2000	NONE	